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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/733,276	12/12/2003	Han Choon Lee	040044-0307078	8236

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EXAMINER	
NGUYEN, THANH T	
ART UNIT	**PAPER NUMBER**
2813	

DATE MAILED: 09/06/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/733,276	LEE, HAN CHOON	
	Examiner	Art Unit	
	Thanh T. Nguyen	2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *28 July 2005*.

2a)☒ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *2,8,9,11,13 and 14* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *11,13 and 14* is/are allowed.

6)☒ Claim(s) *2,8 and 9* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Request for Continued Examination

The request filed on 7/28/05 for a Request for Continued Examination (RCE) under 37 CFR 1.114 is acceptable and an RCE has been established. An action on the RCE follows.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 2, 8 are rejected under 35 U.S.C. 102(b) as being anticipated by Lin (U.S. Patent No. 6,218,303).

Referring to figures 1-4, Lin teaches a method of manufacturing a semiconductor device comprising:

Forming a first insulating layer (38) on a semiconductor substrate (10);

Forming a first conductive line (56) by depositing a conductive material (copper, see figure 3, col. 3, lines 14-16, meeting claims 2, 11) on the first insulating layer and selectively

patterning the conductive material (noted that the conductive layer is only formed in the opening and the trench);

Forming a second insulating layer (70/72) by depositing an insulating material on top of the substrate (10) including on the first conductive line (56, see figure 3);

Forming a via hole (76) and a trench (74) by selectively patterning the second insulating layer to expose a certain portion of the first conductive line (56, see figure 3); and

Removing a natural oxide layer (CuO, see figure 3, col. 3, lines 48-67, col. 4, lines 1-10), formed on the first conductive line (56) through natural oxidation of the first conductive line, by heat treating in an H_2+CO gas atmosphere (see col. 3, lines 57-67);

Forming a metal barrier (64, tantalum barrier) by depositing a metal layer on top of the substrate in the via hole (76) and on the trench (74) (see figures 1-3, col. 4, lines 23-24);

Forming a copper seed layer (see figure 1-2, col. 4, lines 25-26) on top of the metal barrier (64); and

Removing a natural copper oxide layer formed on the copper seed layer through natural oxidation of the copper oxide layer by heat treating in H2+CO gas atmosphere (see col. 4, lines 34-37, wherein more levels of metal can be form and the step S12-S20 is repeated by depositing the dielectric layer and expose the copper and treat with H2+CO). Noted that the term "on" does not mean directly on and in contact with.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lin (U.S. Patent No. 6,218,303) as applied to claims 2, 8 above in view of an ordinary skill in the art..

Lin teaches a method of manufacturing a semiconductor device comprising:

Forming a first insulating layer (38) on a semiconductor substrate (10);

Forming a first conductive line (56) by depositing a conductive material (copper, see figure 3, col. 3, lines 14-16, meeting claims 2, 11) on the first insulating layer and selectively patterning the conductive material (noted that the conductive layer is only formed in the opening and the trench);

Forming a second insulating layer (70/72) by depositing an insulating material on top of the substrate (10) including on the first conductive line (56, see figure 3);

Forming a via hole (76) and a trench (74) by selectively patterning the second insulating layer to expose a certain portion of the first conductive line (56, see figure 3); and

Removing a natural oxide layer (CuO, see figure 3, col. 3, lines 48-67, col. 4, lines 1-10), formed on the first conductive line (56) through natural oxidation of the first conductive line, by heat treating in an H_2+CO gas atmosphere (see col. 3, lines 57-67);

Forming a metal barrier (64, tantalum barrier) by depositing a metal layer on top of the substrate in the via hole (76) and on the trench (74) (see figures 1-3, col. 4, lines 23-24);

Forming a copper seed layer (see figure 1-2, col. 4, lines 25-26) on top of the metal barrier (64); and

Removing a natural copper oxide layer formed on the copper seed layer through natural oxidation of the copper oxide layer by heat treating in H2+CO gas atmosphere (see col. 4, lines 34-37, wherein more levels of metal can be form and the step S12-S20 is repeated by depositing the dielectric layer and expose the copper and treat with H2+CO). Noted that the term "on" does not mean directly on and in contact with.

However, the reference does not teach the temperature range.

The temperature range of claims 9 are considered to involve routine optimization while has been held to be within the level of ordinary skill in the art. As noted in In re Aller, the selection of reaction parameters such as temperature and concentration would have been obvious:

> ANormally, it is to be expected that a change in temperature, or in concentration, or in both, would be an unpatentable modification. Under some circumstances, however, changes such as these may impart patentability to a process if the particular ranges claimed produce a new and unexpected result which is different in kind and not merely degree from the results of the prior art...such ranges are termed Acritical ranges and the applicant has the burden of proving such criticality.... More particularly, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation.
> *In re Aller 105 USPQ233, 255 (CCPA 1955). See also In re Waite 77 USPQ 586 (CCPA 1948); In re Scherl 70 USPQ 204 (CCPA 1946); In re Irmscher 66 USPQ 314 (CCPA 1945); In re Norman 66 USPQ 308 (CCPA 1945); In re Swenson 56 USPQ 372 (CCPA 1942); In re Sola 25 USPQ 433 (CCPA 1935); In re Dreyfus 24 USPQ 52 (CCPA 1934).*

Therefore, one of ordinary skill in the requisite art at the time the invention was made would have used any temperature range suitable to the method in process of Lin in order to optimize the process.

Allowable Subject Matter

Claims 11, 13-14 are allowed because none of the prior art alone on in combination teaches a method of depositing a conductive material on the treated copper seed layer to fill the via hole and the trench and forming a plug and conductive line by planarizing the conductive material on the second insulating layer in order to exposed the second insulating layer, and removing a natural oxide layer formed on the second conductive line through natural oxidations of the second conductive line by heat treating in H2+CO.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanh Nguyen whose telephone number is (571) 272-1695, or by Email via address Thanh.Nguyen@uspto.gov. The examiner can normally be reached on Monday-Thursday from 6:00AM to 3:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr., can be reached on (571) 272-1702. The fax phone number for this Group is (571) 273-8300.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956 (**See MPEP 203.08**).

Thanh Nguyen
Patent Examiner
Patent Examining Group 2800

TTN